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Performance analysis of different modulation formats in 4-channel CATV transmission system using OADM

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ABSTRACT

In this paper we have analyzed the performance of different modulation formats for a four-channel WDM CATV system using optical ad drop multiplexers and the impact of frequency and wavelength on *Q*-value, and eye opening is observed for added and dropped channels at different lengths.

1. Introduction

With the recent development optical networks require a variety of new features of which are security and reliability. Since the information carried by the optical carrier is too large and requires features that ensures the signal is always up to the user even in damage whatsoever [1,4]. To meet up the rapid development will require further improvements in the existing optical networks by using OADM (optical add–drop multiplexer). Optical multiplexers are specially designed for WDM (wavelength division multiplexing) systems. The demultiplexers undo the operation which the multiplexers have done. It separates the multiplicity of wavelengths into fiber and directs them to many fibers. Optical multiplexers are used to couple two or more wavelengths into a single fiber. If a demultiplexer and a multiplexer are properly aligned and placed back-to-back, it is clear that in the area between them, two individual wavelengths exist [9,10]. This presents an opportunity for an enhanced function, one in which individual wavelengths could be removed and also inserted. Such a function would be called an optical wavelength add and drop multiplexer/demultiplexer or we can say optical add–drop multiplexer (OADM). The OADM selectively removes (drops) a wavelength from a multiplicity of wavelengths in a fiber, and thus from the traffic on the particular channel. It then adds in the same direction of data flow the same wavelength, but with different data content. Mohammad Syuhaimi Ab-Rahman [1] proposed a paper to do improvements in the function of OADM devices by combining these two devices in parallel. This increases the reliability of an optical network. Ahmed Nabih Zaki Rashed [2] discussed that the OADM based on DWDM (dense wavelength division multiplexing) technology is moving the telecommunications industry significantly closer to the development of optical networks. The OADM can be placed between two end terminals along any route and be substituted for an optical amplifier. Commercially available OADM allows carriers to drop and/or add up to multi channels between DWDM terminals. By deploying an OADM instead of optical amplifier, service providers can gain flexibility to distribute revenue-generating traffic and reduce costs associated with deploying end terminals at low traffic areas along a route. This paper has proposed OADM for high transmission bit rates at room temperature for best performance efficiency. It is observed that the decreased number of transmitted channels increased the optical transmitted power. Optical Add/drop comprised many optical passive devices such as Fiber Bragg grating, interference filters, circulators and Mach–Zehnder interferometer. Although add/drop filters including those devices have good operating performances, their cost is too expensive to apply for DWDM based optical networks [5,6]. Mohammad Syuhaimi Ab-Rahman [3,8] discussed that wavelength selective add–drop filter is required for adding and dropping a particular wavelength division multiplexing channel at each subscriber's node in the WDM based optical networks. We came to our results with the help of Simulative analysis of integrated DWDM and MIMO-OFDM system with OADM was done recently for optical-OFDM system [11] and monitoring and compensation of optical telecommunication channels [12].

2. Simulation setup

The main function of an optical multiplexer is to couple two or more wavelengths into single fiber. OADMs are classified as

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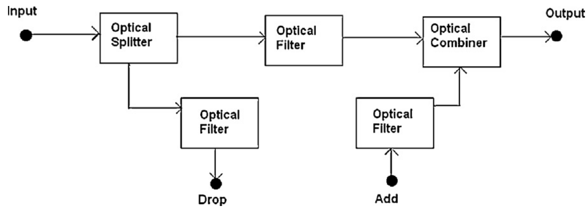

Fig. 1. Simple optical add–drop multiplexer [G.P. Aggrwal].

fixed-wavelength and as dynamically wavelength selectable OADMs. In fixed wavelength OADM, the wavelength has been selected and remains the same until human intervention changes it. In dynamically selectable wavelength OADM, the wavelength between the optical multiplexer may be dynamically directed from the outputs of the demultiplexer to any of the inputs to multiplexer. We use ideal optical add–drop multiplexer without optical loss and crosstalk.

In simple OADM first component is optical splitter as shown in Fig. 1.This component implements a balanced splitter with the same attenuation on each output. If unbalanced splitter is required, simply follow the splitter with the proper attenuation on each side. If the attenuation is set to 0 dB, this component implements an ideal splitter without any insertion loss, i.e. a component perfectly splits the input signal. Optical filter simulates an optical fiber. In our experiment we use Raised-Cosine-Notch filter. Next component is optical combiner. This component implements a balanced combiner with the same attenuation on each input. If unbalanced combiner is required, simply precede the combiner with the proper attenuation on each input. If the attenuation is set to the default value 0 dB, the component implements an ideal combiner without any insertion loss, i.e. a component that perfectly adds the input signals (Fig. 2).

3. Results and discussion

The different modulation formats have been compared for 4-channel CATV transmission system in the terms of *Q* value, BER, eye opening, eye closure and jitter. In CATV transmission system we have 4-channel WDM transmitter by which we transmit different modulation format through 4 channels. We find *Q*-value, BER, eye opening, eye closure and jitter for different modulation format in each channel. Eye diagram for different modulation formats is given (Fig. 3).

Electrical scope is used to view the eye diagram of channels. Electrical scope have bit rate 10 Gb/s. It is the bit rate of input signals. Electrical input is given to this component. This component simulates an oscilloscope for electrical signals. It collects data that will be available for eye diagrams (Figs. 4 and 5).

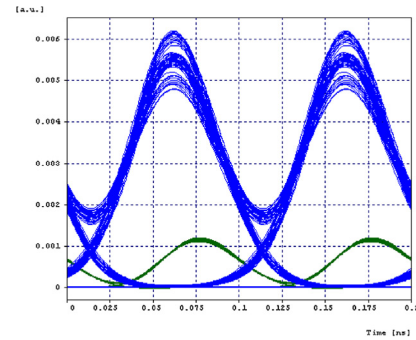

Fig. 3. Superimposed eye diagram of 4-channels.

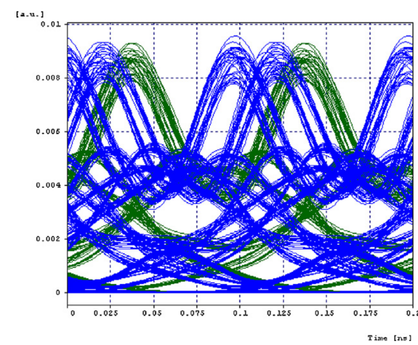

Fig. 4. Superimposed eye diagram of inserted and dropped channel 2.

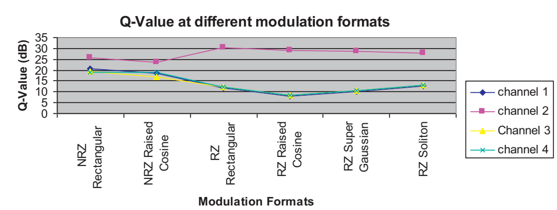

Fig. 5. *Q*-value at different modulation formats in 4-CATV transmission channels.

Optsim simulates the *Q*-value. *Q*-value is the ratio of mean and standard deviation of received signals. To have good estimation of *Q*-value 100–200 bits are simulated so to have a good accuracy on the evaluation of the mean and standard deviation on the received signal. We can set the number of simulated bits at given bit rate (Fig. 6).

The evaluation of the BER in optical system simulation is in general a nontrivial task. Error counting is usually impracticable, since the target BER is typically of the order of 109. Therefore to measure

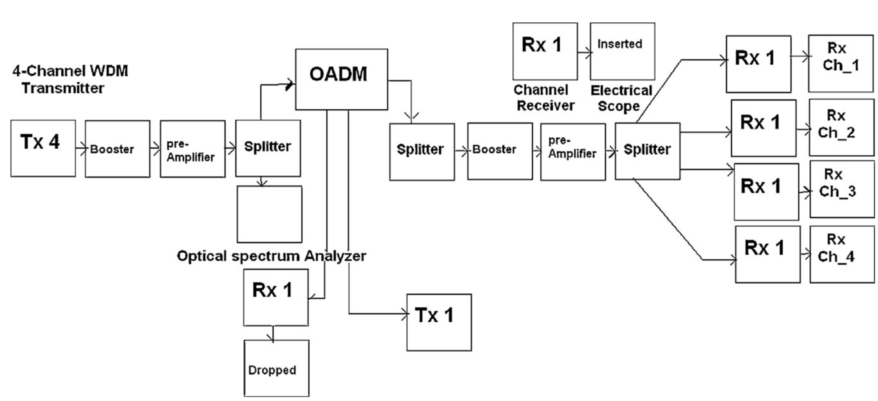

Fig. 2. Germanized block diagram for CATV 4-channel transmission system [Senior].